Claims

1. A substrate having an exterior surface that is durable to a selected washing fluid, the exterior surface carrying a temporary protective cover comprising a sputtered film that protects the exterior surface against contamination but that can readily be removed from the exterior surface by washing with the selected washing fluid.

2. The substrate of claim 1 wherein the exterior surface is formed by the substrate itself.

3. The substrate of claim 1 wherein the exterior surface is formed by a durable coating on the substrate.

4. The substrate of claim 1 wherein the cover is stable in the presence of water but breaks down in the presence of a weak acid or a weak base

5. The substrate of claim 1 wherein the cover is durable to elevated temperatures on the order of about 600°C.

6. The substrate of claim 1 wherein the cover comprises an oxide of a metal.

7. The substrate of claim 6 wherein the cover comprises an oxide of a metal selected from the group consisting of zinc, bismuth, cadmium, iron, and nickel.

8. The substrate of claim 7 wherein the cover comprises zinc oxide.

9. The substrate of claim 1 wherein the cover has a thickness of less than about 2500 angstroms.

10. The substrate of claim 9 wherein the cover has a thickness of less than about 100 angstroms.

11. The substrate of claim 10 wherein the cover has a thickness of between about 25 angstroms and about 60 angstroms.

12. The substrate of claim 1 wherein the cover is stable in the presence of water but breaks down in the presence of vinegar.

13. The substrate of claim 3 wherein the durable coating is formed directly upon the substrate.

14. The substrate of claim 3 wherein the cover is formed directly upon the durable coating.

15. The substrate of claim 14 wherein the durable coating is an oxide.

16. The substrate of claim 15 wherein the oxide is formed directly upon the substrate.

17. The substrate of claim 3 wherein the durable coating is a hydrophilic coating.

18. The substrate of claim 17 wherein the hydrophilic coating has a contact angle with water of less than about 25 degrees when the cover is removed.

19. The substrate of claim 17 wherein the hydrophilic coating comprises silicon dioxide.

20. The substrate of claim 19 wherein the silicon dioxide is substantially non-porous.

21. The substrate of claim 17 wherein the hydrophilic coating is formed upon an infrared-reflective coating previously deposited on the substrate.

22. The substrate of claim 21 wherein the infrared-reflective coating comprises at least one pyrolytically-applied layer.

23. The substrate of claim 3 wherein the durable coating is a photocatalytic coating.

24. The substrate of claim 23 wherein the cover comprises an inorganic material.

25. The substrate of claim 23 wherein the photocatalytic coating comprises titanium oxide.

26. The substrate of claim 1 further comprising an infrared-reflective coating on an interior surface of the substrate.

27. The substrate of claim 26 wherein the infrared-reflective coating comprises, moving outward from the substrate, at least one dielectric layer, a metal layer, and a further dielectric layer.

28. A substrate bearing an exterior coating that is durable to a selected washing fluid, the exterior coating carrying a temporary protective cover comprising a film sputtered directly upon the exterior coating, wherein the cover protects the exterior coating against contamination but can readily be removed from the exterior coating by washing with the selected washing fluid.

29. The substrate of claim 28 wherein the exterior coating comprises an oxide of a metal.

30. The substrate of claim 28 wherein the sputtered film comprises an oxide of a metal.

31. The substrate of claim 30 wherein the sputtered film comprises an oxide of a metal selected from the group consisting of zinc, bismuth, cadmium, iron, and nickel.

32. The substrate of claim 31 wherein the sputtered film comprises zinc oxide.

33. A substrate having an exterior surface that is durable to a selected washing fluid, the exterior surface carrying a temporary protective cover that protects the exterior surface against contamination, wherein the cover is durable to elevated temperatures on the order of about 600°C but can readily be removed from the exterior surface by washing with the selected washing fluid.

34. The substrate of claim 33 wherein the cover is stable in the presence of water but breaks down in the presence of a weak acid or a weak base.

35. The substrate of claim 33 wherein the cover comprises an oxide of a metal.

36. The substrate of claim 35 wherein the cover comprises an oxide of a metal selected from the group consisting of zinc, bismuth, cadmium, iron, and nickel.

37. The substrate of claim 36 wherein the cover comprises zinc oxide.

38. The substrate of claim 33 wherein the cover has a thickness of less than about 2500 angstroms.

39. The substrate of claim 38 wherein the cover has a thickness of less than about 100 angstroms.

40. The substrate of claim 39 wherein the cover has a thickness of between about 25 angstroms and about 60 angstroms.

41. The substrate of claim 33 wherein the cover comprises a sputtered film.

42. An insulating glass unit comprising spaced-apart panes having confronting interior surfaces that bound a between-pane space, at least one of the panes having an exterior surface that is durable to a selected washing fluid, the exterior surface carrying a temporary protective cover comprising a sputtered film that protects the exterior surface against contamination but that can readily be removed from the exterior surface by washing with the selected washing fluid.

43. The insulating glass unit of claim 42 wherein the sputtered film is stable in the presence of water.

44. The insulating glass unit of claim 43 wherein the sputtered film breaks down in the presence of a mild acid or a mild base.

45. The insulating glass unit of claim 42 wherein the panes are glass and at least the pane carrying the cover is tempered glass.

46. The insulating glass unit of claim 42 wherein the sputtered film is durable to elevated temperatures on the order of about 600°C.

47. The insulating glass unit of claim 42 wherein the sputtered film comprises an oxide of a metal.

48. The insulating glass unit of claim 47 wherein the sputtered film comprises an oxide of a metal selected from the group consisting of zinc, bismuth, cadmium, iron, and nickel.

49. The insulating glass unit of claim 48 wherein the sputtered film comprises zinc oxide.

50. The insulating glass unit of claim 42 wherein the sputtered film has a thickness of less than about 100 angstroms.

51. The insulating glass unit of claim 50 wherein the sputtered film has a thickness of between about 25 angstroms and about 60 angstroms.

52. The insulating glass unit of claim 42 wherein at least one of said confronting interior surfaces bears an infrared-reflective coating.

53. The insulating glass unit of claim 52 wherein the infrared-reflective coating comprises, moving outwardly from the substrate, at least one dielectric layer, a metal layer, and a further dielectric layer.

54. A method of producing substrates, the method comprising:

a) providing a substrate having generally-opposed interior and exterior surfaces;

b) forming a durable coating upon the exterior surface of the substrate, said coating comprising material that is durable to a selected washing fluid; and

c) sputtering a temporary protective cover over the durable coating, the cover comprising material that protects the durable coating against contamination but that can readily be removed by washing with the selected washing fluid.

55. The method of claim 54 wherein the durable coating is formed by sputtering.

56. The method of claim 54 wherein the durable coating is a hydrophilic coating deposited by sputtering a silicon target in an oxidizing atmosphere.

57. The method of claim 54 wherein the durable coating is a photocatalytic coating depositing by sputtering a titanium-containing target.

58. The method of claim 54 wherein the temporary protective cover is formed by sputtering upon the durable coating an oxide of a metal selected from the group consisting of zinc, bismuth, cadmium, iron, and nickel.

59. The method of claim 54 wherein the temporary protective cover is durable to elevated temperatures on the order of about 600°C, the method further comprising tempering the covered substrate.

60. The method of claim 54 further comprising incorporating the covered substrate into an insulating glass unit.

61. The method of claim 54 further comprising delivering the covered substrate to a customer.

62. The method of claim 54 further comprising installing the covered substrate in a window frame.

63. A method of processing substrates, the method comprising:

a) providing a substrate having an exterior surface that is durable to a selected washing fluid, the exterior surface carrying a temporary protective cover comprising a

sputtered film that protects the exterior surface against contamination but that can readily be removed from the exterior surface by washing with the selected washing fluid; and

b) washing the covered exterior surface of the substrate with the selected washing fluid to remove at least a portion of the cover, thereby exposing at least a portion of the underlying exterior surface.

64. The method of claim 63 wherein said washing fluid comprises a mild acid or a mild base.

65. The method of claim 64 wherein said washing fluid comprises vinegar.

66. The method of claim 65 wherein said washing removes substantially the entire cover.

67. The method of claim 66 further comprising incorporating the covered substrate into an insulating glass unit prior to said washing step.

68. The method of claim 66 further comprising delivering the covered substrate to a customer prior to said washing step.

69. The method of claim 66 further comprising installing the covered substrate in a window frame prior to said washing step.

70. The method of claim 66 wherein the cover is durable to elevated temperatures on the order of about 600°C, the method further comprising tempering the covered substrate.

71. A window assembly comprising:

a) a window pane having an exterior surface that is durable to a selected washing fluid, the exterior surface carrying a temporary protective cover comprising a sputtered film that can readily be removed by washing with the selected washing fluid; and

b) a frame structure to which the pane is secured by a bead of sealant, the bead of sealant being bonded on a first side directly to a peripheral portion of the protective cover, said peripheral portion of the cover overlying a peripheral region of the pane's exterior surface, the bead of sealant being bonded on a second side to the frame structure.

72. The window assembly of claim 71 wherein cover has been removed from a central portion of the pane's exterior surface.

73. A method of processing substrates, the method comprising:

a) providing a substrate having an interior surface and an exterior surface and a sputtering line comprising a series of connected sputtering chambers, each chamber having a substrate support positioned therein, a first sputtering chamber comprising a first lower target positioned below the support in the first chamber, a second sputtering chamber comprising a second lower target positioned below the support in the second chamber;

b) positioning the substrate on the support in the first sputtering chamber such that the exterior surface of the substrate is oriented toward the first lower target, and sputtering the first lower target to deposit a first coating onto the exterior surface of the substrate, the first coating comprising material that is durable to a selected washing fluid; and

c) positioning the substrate on the support in the second sputtering chamber such that the exterior surface is oriented toward the second lower target, and sputtering the second lower target to deposit a second coating onto the first coating, the second coating comprising material that can readily be removed from the first coating by washing with the selected washing fluid.

74. The method of claim 73 wherein the first coating is a hydrophilic coating and the first lower target comprises silicon, wherein the first lower target is sputtered in an oxidizing atmosphere.

75. The method of claim 73 wherein the first coating is a photocatalytic coating and the first lower target comprises titanium, wherein the first lower target is sputtered in an atmosphere comprising inert gas or inert gas and oxygen.

76. The method of claim 73 wherein the second coating is a temporary protective cover and the second lower target comprises a metal, wherein the second lower target is sputtered in an oxidizing atmosphere.

77. The method of claim 73 wherein the second coating is a temporary protective cover and the second lower target comprises a metal selected from the group consisting of zinc, bismuth, cadmium, iron, and nickel, wherein the second lower target is sputtered in an oxidizing atmosphere.

78. The method of claim 73 wherein the second coating is a temporary protective cover and the second lower target comprises zinc, wherein the second lower target is sputtered in an oxidizing atmosphere.

79. The method of claim 73 further comprising a downward sputtering chamber having an upper target positioned above the support therein, the upper target being sputtered to deposit an interior coating on the interior surface of the substrate or on a film previously deposited upon the interior surface.

80. The method of claim 79 wherein the interior coating is low-emissivity coating or a film forming part of a low-emissivity coating and the upper target comprises a metal, wherein the upper target is sputtered in an oxidizing atmosphere.

81. The method of claim 73 further comprising a dual-direction sputtering chamber having a second upper target positioned above the support therein and having a third lower target positioned below the support therein, the second upper target and the third lower target being sputtered at substantially the same time.